The invention claimed is as follows.

1. An energy absorption impact system for vehicle bumpers and the like, comprising:

a mounting plate adapted to be connected with a vehicle frame, and including a central opening extending therethrough; and

a generally box-shaped, sheet metal energy absorbing crush member having a top wall, a bottom wall and opposite sidewalls arranged in a generally frustro-pyramidal shape, defining a larger end thereof adapted for connection with a vehicle bumper, and a smaller end thereof connected with said mounting plate about said central opening therein, whereby impact on the vehicle bumper inelastically deforms said top wall, said bottom wall and said opposite sidewalls of said crush member toward said central opening in said mounting plate to absorb energy associated with the impact.

2. An energy absorption impact system as set forth in claim 1, wherein:

said mounting plate includes at least one tab extending forwardly from said central opening and being rigidly connected with an adjacent one of said top wall, said bottom wall and said opposite sidewalls of said crush member.

3. An energy absorption impact system as set forth in claim 2, wherein:

said tab is connected with an interior surface of said one wall of said crush member, and folds inwardly with said one wall toward said central opening of said mounting plate upon impact to control energy absorption.

4. An energy absorption impact system as set forth in claim 4, wherein:

said sidewalls include an innermost sidewall facing a central portion of the vehicle bumper, and an outermost sidewall facing an end portion of the vehicle bumper; and

said tab is rigidly connected with the interior surface of said outermost sidewall to absorb energy from an impact having a significant side component.

5. An energy absorption impact system as set forth in claim 4, wherein:

said tab is integral with said mounting plate to define a one-piece structure.

6. An energy absorption impact system as set forth in claim 5, wherein:

said tab is stamped from material disposed within said central opening and bent forwardly along a fold edge.

7. An energy absorption impact system as set forth in claim 6, wherein:

said mounting plate includes a stiffening bead extending about the periphery of said central opening.

8. An energy absorption impact system as set forth in claim 7, wherein:

said central opening is defined by a top edge, a bottom edge and opposite side edges; and

each of said edges of said central opening includes one of said tabs extending forwardly therefrom.

9. An energy absorption impact system as set forth in claim 8, wherein:

at least one of said sidewalls is disposed at a predetermined acute angle relative to an adjacent outer portion of said mounting plate to define at least a portion of said generally frustro-pyramidal shape.

10. An energy absorption impact system as set forth in claim 8, wherein:

each of said sidewalls is disposed at a predetermined acute angle relative to an adjacent outer portion of said mounting plate to define at least a portion of said generally frustro-pyramidal shape.

11. An energy absorption impact system as set forth in claim 10, wherein:

said top wall is disposed at a predetermined acute angle relative to an adjacent outer portion of said mounting plate to define at least a portion of said generally frustro-pyramidal shape.

12. An energy absorption impact system as set forth in claim 11, wherein:

said bottom wall is disposed at a predetermined acute angle relative to an adjacent outer portion of said mounting plate to define at least a portion of said generally frustro-pyramidal shape.

13. An energy absorption impact system as set forth in claim 12, wherein:

said predetermined acute angle of each of said sidewalls of said crush member is substantially identical.

14. An energy absorption impact system as set forth in claim 13, wherein:

said predetermined acute angle of said top wall and said bottom wall of said crush member is substantially identical.

15. An energy absorption impact system as set forth in claim 14, wherein:

said predetermined acute angle of said top wall, said bottom wall and said opposite sidewalls is adjusted to vary the energy absorption for a specified impact system.

16. An energy absorption impact system as set forth in claim 15, wherein:

said top wall, said bottom wall and said sidewalls each have a predetermined thickness which is adjusted to vary the energy absorption for a specified impact system.

17. An energy absorption impact system as set forth in claim 16, wherein:

said crush member comprises first and second channel members, each having a substantially identical C-shaped lateral cross-sectional configuration with opposed side edges thereof rigidly interconnected along opposite seams to define said generally frustro-pyramidal shape.

18. An energy absorption impact system as set forth in claim 17, wherein:

said opposed seams are disposed in said top wall and said bottom wall.

19. An energy absorption impact system as set forth in claim 17, wherein:

said opposed seams are disposed in said sidewalls.

20. An energy absorption impact system as set forth in claim 19, wherein:

said mounting plate has a generally flat outer portion, with a marginal edge having a stiffening bead extending along at least a portion thereof; and

said outer portion of said mounting plate is spot welded to an open forward end of the vehicle frame.

21. An energy absorption impact system as set forth in claim 20, including:

fasteners detachably connecting said top wall, said bottom wall and said opposite sidewalls with said tabs to facilitate replacement of said crush member.

22. An energy absorption impact system as set forth in claim 21, wherein:

said tabs are disposed at an angle relative to the outer portion of said mounting plate which is greater than the predetermined acute angle of said top wall, and said opposite side walls, such that said fasteners resiliently bias said tabs abuttingly against said walls to preload said fasteners and securely retain the same in place.

23. An energy absorption impact system as set forth in claim 22, including:

weld nuts attached to said tabs and receiving said fasteners therein.

24. An energy absorption impact system as set forth in claim 23, wherein:

said mounting plate and said crush member are constructed from high strength steel.

25. An energy absorption impact system as set forth in claim 2, wherein:

said sidewalls include an innermost sidewall facing a central portion of the vehicle bumper, and an outermost sidewall facing an end portion of the vehicle bumper; and

said tab is rigidly connected with the interior surface of said outermost sidewall to absorb energy from an impact having a significant side component.

26. An energy absorption impact system as set forth in claim 2, wherein:

said tab is integral with said mounting plate to define a one-piece structure.

27. An energy absorption impact system as set forth in claim 2, wherein:

said tab is stamped from material disposed within said central opening and bent forwardly along a fold edge.

28. An energy absorption impact system as set forth in claim 1, wherein:

said mounting plate includes a stiffening bead extending about the periphery of said central opening.

29. An energy absorption impact system as set forth in claim 1, wherein:

said central opening is defined by a top edge, a bottom edge and opposite side edges; and

each of said edges of said central opening includes a tab extending forwardly therefrom.

30. An energy absorption impact system as set forth in claim 1, wherein:

at least one of said sidewalls is disposed at a predetermined acute angle relative to an adjacent outer portion of said mounting plate to define at least a portion of said generally frustro-pyramidal shape.

31. An energy absorption impact system as set forth in claim 1, wherein:

each of said sidewalls is disposed at a predetermined acute angle relative to an adjacent outer portion of said mounting plate to define at least a portion of said generally frustro-pyramidal shape.

32. An energy absorption impact system as set forth in claim 31, wherein:

said predetermined acute angle of each of said sidewalls of said crush member is substantially identical.

33. An energy absorption impact system as set forth in claim 1, wherein:

said top wall is disposed at a predetermined acute angle relative to an adjacent outer portion of said mounting plate to define at least a portion of said generally frustro-pyramidal shape.

34. An energy absorption impact system as set forth in claim 33, wherein:

said bottom wall is disposed at a predetermined acute angle relative to an adjacent outer portion of said mounting plate to define at least a portion of said generally frustro-pyramidal shape.

35. An energy absorption impact system as set forth in claim 34, wherein:

said predetermined acute angle of said top wall and said bottom wall of said crush member is substantially identical.

36. An energy absorption impact system as set forth in claim 31, wherein:

said predetermined acute angle of said opposite sidewalls is adjusted to vary the energy absorption for a specified impact system.

37. An energy absorption impact system as set forth in claim 1, wherein:

said top wall, said bottom wall and said sidewalls each have a predetermined thickness which is adjusted to vary the energy absorption for a specified impact system.

38. An energy absorption impact system as set forth in claim 1, wherein:

said crush member comprises first and second channel members, each having a substantially identical C-shaped lateral cross-sectional configuration with opposed side edges thereof rigidly interconnected along opposite seams to define said generally frustro-pyramidal shape.

39. An energy absorption impact system as set forth in claim 38, wherein:

said opposed seams are disposed in said top wall and said bottom wall.

40. An energy absorption impact system as set forth in claim 1, wherein:

said mounting plate has a generally flat outer portion, with a marginal edge having a stiffening bead extending along at least a portion thereof; and

said outer portion of said mounting plate is spot welded to an open forward end of the vehicle frame.

41. An energy absorption impact system as set forth in claim 2, including:

a fastener detachably connecting said one wall of said crush member with said tab to facilitate replacement of said crush member.

42. An energy absorption impact system as set forth in claim 41, wherein:

said tab is disposed at an angle relative to the outer portion of said mounting plate which is greater than the predetermined acute angle of said one wall, such that said fastener

resiliently biases said tab abuttingly against said one wall to preload said fastener and securely retain the same in place.

43. An energy absorption impact system as set forth in claim 41, including:

a weld nut attached to said tab and receiving said fastener therein.

44. An energy absorption impact system as set forth in claim 1, wherein:

said mounting plate and said crush member are constructed from high strength steel.

45. A method for making an energy absorption impact system for vehicle bumpers and the like, comprising:

forming a mounting plate with a central opening therethrough;

forming a generally box-shaped, sheet metal energy absorbing crush member having a top wall, a bottom wall and opposite sidewalls arranged in a generally frustro-pyramidal shape, defining a lager end thereof adapted for connection with a vehicle bumper, and a smaller end thereof adapted for connection with said mounting plate;

positioning the smaller end of the crush member on the mounting plate about the central opening;

rigidly fastening the smaller end of the crush member to the mounting plate;

rigidly fastening the mounting plate to an end of a vehicle frame; and

connecting a vehicle bumper to the larger end of the crush member, whereby impact on the vehicle bumper inelastically deforms the top wall, the bottom wall and the opposite

sidewalls of the crush member toward the central opening in the mounting plate to absorb energy associated with the impact.

46. A method as set forth in claim 45, wherein:

said mounting plate forming step includes forming at least one tab extending forwardly from the central opening, and rigidly connecting the tab with an adjacent one of the top wall, the bottom wall and the opposite sidewalls of said crush member.

47. A method as set forth in claim 46, wherein:

said tab connecting step includes connecting the tab with an interior surface of the one wall of the crush member, such that the tab folds inwardly with the one wall toward the central opening of the mounting plate upon impact to control energy absorption.

48. A method as set forth in claim 47, wherein:

said tab connecting step includes rigidly connecting the tab to the interior surface of the outermost one of the opposite sidewalls to absorb energy from an impact having a significant side component.

49. A method as set forth in claim 48, wherein:

said tab forming step includes forming the tab integral with the mounting plate to define a one-piece structure.

50. A method as set forth in claim 49, wherein:

said tab forming step includes stamping the tab from material disposed within the central opening and bending the tab forwardly along a fold edge.

51. A method as set forth in claim 50, wherein:

said mounting plate forming step includes forming a stiffening bead about the periphery of the central opening.

52. A method as set forth in claim 51, wherein:

the central opening is defined by a top edge, a bottom edge and opposite side edges; and

said tab forming step includes forming one of the tabs at each of the edges of the central opening and bending the tabs forwardly therefrom.

53. A method as set forth in claim 52, wherein:

said crush member forming step includes positioning at least one of the sidewalls at a predetermined acute angle relative to the adjacent outer portion of the mounting plate to define at least a portion of the generally frustro-pyramidal shape.

54. A method as set forth in claim 53, wherein:

said crush member forming step includes positioning each of the sidewalls at a predetermined acute angle relative to the adjacent outer portion of the mounting plate to define at least a portion of the generally frustro-pyramidal shape.

55. A method as set forth in claim 54, wherein:

said crush member forming step includes positioning the top wall at a predetermined acute angle relative to the adjacent outer portion of the mounting plate to define at least a portion of the generally frustro-pyramidal shape.

56. A method as set forth in claim 55, wherein:

said crush box forming step includes positioning the bottom wall at a predetermined acute angle relative to the adjacent outer portion of the mounting plate to define at least a portion of the generally frustro-pyramidal shape.

57. A method as set forth in claim 56, wherein:

said sidewall positioning step includes positioning each of the sidewalls of the crush member at a substantially identical, predetermined acute angle.

58. A method as set forth in claim 57, wherein:

said top and bottom wall positioning step includes positioning the top wall and the bottom wall of the crush member at a substantially identical, predetermined acute angle.

59. A method as set forth in claim 58, wherein:

said crush member wall positioning step includes adjusting the predetermined acute angle of the top wall, the bottom wall and the opposite sidewalls to achieve the desired energy absorption for a specified impact system.

60. A method as set forth in claim 59, wherein:

said crush member forming step comprises selecting a predetermined wall thickness for the top wall, the bottom wall and the sidewalls to achieve the desired energy absorption for a specified impact system.

61. A method as set forth in claim 60, wherein:

said crush member forming step comprises forming first and second channel members, each having a substantially identical C-shaped lateral cross-sectional configuration, positioning opposed side edges of the channel members together, and rigidly interconnecting the opposed side edges along opposite seams to define the generally frustro-pyramidal shape.

62. A method as set forth in claim 61, wherein:

said channel member connecting step includes forming the opposed seams in the top wall and the bottom wall.

63. A method as set forth in claim 61, wherein:

said channel member connecting step includes forming the opposed seams in the opposite sidewalls.

64. A method as set forth in claim 62, wherein:

said mounting plate forming step includes forming the mounting plate with a generally flat outer portion, and with a marginal edge having a stiffening bead extending along at least a portion thereof.

65. A method as set forth in claim 64, wherein:

said mounting plate fastening step includes spot welding the outer portion of the mounting plate to an open forward end of the vehicle frame.

66. A method as set forth in claim 65, wherein:

said tab connecting step includes inserting threaded fasteners between the top wall, the bottom, the opposite side walls and the tabs to facilitate replacement of said crush member.

67. A method as set forth in claim 66, wherein:

said tab forming step includes forming the tabs at an angle relative to the outer portion of the mounting plate which is greater than the predetermined acute angle of the top wall, the bottom wall and the opposite sidewalls, such that the fasteners resiliently bias said tabs abuttingly against the walls to preload the fasteners and securely retain the same in place.

68. A method as set forth in claim 67, including:

attaching weld nuts to the tabs to receive the fasteners therein.

69. A method as set forth in claim 68, wherein:

said mounting plate forming step includes forming the mounting plate from high strength steel.

70. A method as set forth in claim 69, wherein:

said crush member forming step includes forming the crush member from high strength steel.

71. A method as set forth in claim 46, wherein:

said tab connecting step includes rigidly connecting the tab to an interior surface of an outermost one of the opposite sidewalls to absorb energy from an impact having a significant side component.

72. A method as set forth in claim 46, wherein:

said tab forming step includes stamping the tab from material disposed within the central opening and bending the tab forwardly along a fold edge.

73. A method as set forth in claim 45, wherein:

said mounting plate forming step includes forming a stiffening bead about the periphery of the central opening.

74. A method as set forth in claim 45, wherein:

said crush member forming step includes positioning at least one of the sidewalls at a predetermined acute angle relative to the adjacent outer portion of the mounting plate to define at least a portion of the generally frustro-pyramidal shape.

75. A method as set forth in claim 45, wherein:

said crush member forming step includes positioning at least one of the top wall and bottom wall at a predetermined acute angle relative to the adjacent outer portion of the mounting plate to define at least a portion of the generally frustro-pyramidal shape.

76. A method as set forth in claim 74, wherein:

said crush member wall positioning step includes adjusting the predetermined acute angle of the opposite sidewalls to achieve the desired energy absorption for a specified impact system.

77. A method as set forth in claim 45, wherein:

said crush member forming step comprises selecting a predetermined wall thickness for the top wall, the bottom wall and the sidewalls to achieve the desired energy absorption for a specified impact system.

78. A method as set forth in claim 45, wherein:

said crush member forming step comprises forming first and second channel members, each having a substantially identical C-shaped lateral cross-sectional configuration, positioning opposed side edges of the channel members together, and rigidly interconnecting the opposed side edges along opposite seams to define the generally frustro-pyramidal shape.

79. A method as set forth in claim 45, wherein:

said mounting plate forming step includes forming the mounting plate with a generally flat outer portion, and with a marginal edge having a stiffening bead extending along at least a portion thereof.

80. A method as set forth in claim 45, wherein:

said mounting plate fastening set includes spot welding an outer portion of the mounting plate to an open forward end of the vehicle frame.

81. A method as set forth in claim 46, wherein:

said tab connecting step includes inserting a threaded fastener between the one wall and the tab to facilitate replacement of said crush member.

82. A method as set forth in claim 81, wherein:

said crush member forming step includes positioning the one wall at a predetermined acute angle relative to the adjacent outer portion of the mounting plate to define at least a portion of the generally frustro-pyramidal shape; and

said tab forming step includes from the tab at an angle relative to the outer portion of the mounting plate which is greater than the predetermined acute angle of the one wall, such that the fastener resiliently biases said tab abuttingly against the one wall to preload the fastener and securely retain the same in place.